

Remarks

Upon entry of the instant Amendment, claims 1 and 3-5 will be pending in the application. In the instant Amendment, claim 2 has been canceled, without prejudice. Claims 1 and 4-5 have been amended. Claim 1 has been amended to incorporate the limitations of the canceled claim 2. Claim 1 has also been amended to recite that the ferritic stainless steel welded pipe is superior in expandability by a multi-step process and consists of a matrix and a welded zone. Support for this amendment can be found, for example, at p. 3, lines 7-33 of the specification. Claim 4 has been amended to more clearly recite the claimed method and to recite that in the step of sizing, the circumferential length is sized such that an amount of sizing in circumferential length defined as $((\text{circumferential length before sizing} - \text{circumferential length after sizing}) / \text{circumferential length before sizing})$ is 0.5 to 2.0%. Support for the amendment can be found, for example, at p.10, line 25 to p.11, line 5 of the specification. Claim 4 has additionally been amended to also depend on claim 3, thereby adding back the dependency that was removed in the preliminary amendment filed July 28, 2009. Claim 5 has been amended to make the claim language clearer. Accordingly, no new matter has been introduced.

The amendments are proper in that they place the application in condition for allowance or in better form for appeal.

Rejection under 35 U.S.C. §102

Claim 1 is rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Publication 2003/0183292 which issued as U.S. Patent No. 6,851,455 to Otsuka et al. ("Otsuka") for the reasons set forth at on page 2 of the office action.

While not acquiescing to Examiner's rejection, claim 1 has been amended herein to expedite prosecution of the current application. In particular, claim 1 has been amended to include the limitations of the now canceled claim 2. The rejection to claim 1 under 35 U.S.C. §102(b) has been overcome and should therefore be withdrawn.

Rejection under 35 U.S.C. §103

Claim 3 is rejected under 35 U.S.C. §103(a) as being unpatentable over Otsuka for the reasons set forth on page 3 of the office action. Applicants respectfully traverse.

The present invention is directed to a ferritic stainless steel welded pipe superior in expandability by a multi-step process consisting of a matrix and a welded zone. The ferritic stainless steel welded pipe is characterized in that after forming, welding, and sizing, the matrix of the welded pipe has an elongation in the circumferential direction of 15% or more, and a hardness difference $\Delta HV (= HV_W - HV_M)$ between the Vicker's hardness HV_W of the weld zone and the Vicker's hardness HV_M of the matrix is 10 to 40 in range and in that a ratio $RT (= T_W/T_M)$ between a bead thickness T_W of the weld zone and a thickness T_M of the matrix is 1.05 to 1.3.

Applicants have discovered that in order to improve expandability by a multi-step process and obtaining expandability to two or more times the original pipe diameter, including an eccentric expansion step, adjusting the hardness difference and weld bead thickness between the matrix and the weld zone is important. For example, as is shown in Table 4 of the present application, different types of welded pipes with different production conditions were evaluated for expandability. In particular, for Invention Example Nos. 1 to No. 18, the amounts of alloy elements in the steel composition, the hardness differences between the Vicker's hardness of the weld zone and the Vicker's hardness of the matrix, and the ratios of thickness of the matrix and weld bead are all within the recited range, regardless of the welding method and pipe size, as a result, the resultant welded pipes had either minor cracks or no cracks and had expanded to two times the diameter of the original pipes.

On the other hand, for Comparative Examples Nos. 36 to 42, even though the hardness differences between the Vicker's hardness of the weld zone and the Vicker's hardness of the matrix are within the 10 to 40 range as recited in the present claims, however, the thickness ratios of the matrix and the weld bead are outside the recited range causing cracks near the weld zone. Furthermore, as is shown by the black triangle marks in Figure 5 of the present application, when the hardness difference ΔHV is 10 to 30 or is larger than 30 but the thickness ratio $RT (= T_W/T_M)$ is larger than 1.3, cracks had occur in the inclined direction from the matrix near the weld zone. On the other hand, as is shown by the white diamond marks in Figure 5, when the hardness difference ΔHV is within the recited range of 10 to 40 and the thickness ratio RT is between 1.05 to 1.3, there is minor cracking and two-fold expansion of the original pipe is possible. To suppress even this minor cracking, as is shown by the white square marks in Figure 5, the hardness difference ΔHV is preferably 10 to 30 and the thickness ratio RT is 1.1 to 1.25. Therefore, according to the present invention,

in addition to controlling the hardness between the weld zone and the matrix, the thickness ratios of the matrix and the weld bead must be adjusted to a suitable range.

Otsuka merely teaches an austenitic stainless steel having a hardness of 180 HV or less and Lankford value of 1.2 or more with elongation of 30% or more but does not teach or suggest adjusting the thickness ratios of the matrix and weld bead to the recited range in addition to controlling the hardness between the weld zone and the matrix in order to improve expandability in stainless steel. One skilled in the art would not have arrived at the present inventive feature of a hardness difference between the Vicker's hardness HV_W of the weld zone and the Vicker's hardness HV_M of the matrix of 10 to 40 and a ratio $RT (= T_w / T_m)$ between a bead thickness T_w of the weld zone and a thickness T_m of the matrix is 1.05 to 1.3 as defined in the present claims from the teachings of Otsuka. Therefore, Otsuka provides no reason for one of ordinary skill in the art to seek the presently claimed steel product, and the present claim is not obvious over Otsuka. Accordingly, the rejection of claim 3 under 35 U.S.C. §103(a) as obvious over Otsuka cannot stand, and should be withdrawn.

Claims 2 and 4 are rejected under 35 U.S.C. §103(a) as being unpatentable over Otsuka in view of JP 2000-326079 to Hiroshi, et al. ("Hiroshi") for the reasons set forth on pages 3-4 of the office action.

As discussed above, Otsuka does not render the presently claimed invention obvious. Hiroshi teaches a ferritic stainless steel belt having a hardness difference $\Delta HV (= HV_W - HV_B)$ between the Vicker's hardness HV_W of a weld zone and the Vicker's hardness HV_B of a base material part in the range of 10 to 80. As discussed at p. 7, ll. 4-16 of the specification, in the past it had been proposed to adjust the production conditions such that the difference between the matrix hardness and the weld zone hardness became 10 to 80 in order to obtain a balance in strength of the weld zone and the matrix for improving workability of the welded pipe. But the present inventors found that with multi-step expansion, adjusting the weld zone strength (hardness) alone, a suitable balance of strength between the weld zone and the matrix cannot be obtained and that in addition to controlling the hardness between the weld zone and the matrix, the weld zone bead thickness must also be adjusted to a suitable range. Because Hiroshi does not teach or suggest adjusting the thickness ratios of the matrix and weld bead to the recited range in addition to controlling the hardness between the weld zone and the matrix in order to improve expandability in stainless steel, Hiroshi provides no reason for one of ordinary skill in the art to seek the presently claimed steel product or method for its

production. Therefore, the inventions claimed in claims 2 and 4 are not obvious over Otsuka and Hiroshi, alone or in combination. Accordingly, the rejection of claims 2 and 4 under 35 U.S.C. §103(a) as unpatentable over Otsuka in view of Hiroshi cannot stand, and should be withdrawn.

Claim 5 is rejected under 35 U.S.C. §103(a) as being unpatentable over Otsuka in view of Hiroshi as applied to claims 2 and 4 above, further in view of U.S. Patent No. 6,645,318 to Takahashi, et al. ("Takahashi") for the reasons set forth on page 5 of the office action.

As discussed above, neither Otsuka nor Hiroshi teaches or suggests adjusting the thickness ratios of the matrix and weld bead to the recited range in addition to controlling the hardness between the weld zone and the matrix in order to improve expandability in stainless steel.

Takahashi is concerned with producing a fuel tank made of a ferritic stainless steel sheet having long lasting corrosion resistance under the environment of the fuel tank and excellent in formability when fabricating the fuel tank, more specifically, a fuel tank made of a ferritic stainless steel sheet containing 10 to 25 mass % of Cr and having an average r-value of 1.9 or larger, an r-value in-plane anisotropy Δr of 1.0 or smaller, and a total elongation of 30% or larger, having a plane intensity ratio $I(111)/I(100)$ of 10 or larger, and having lubricant films on the surfaces of the steel sheet and a surface friction coefficient of 0.10 or less. Takahashi is concerned with the influence of the average r-value, Δr , and total elongation of a steel sheet on the formability of the steel sheet. Takahashi, however, does not teach or suggest adjusting the thickness ratios of the matrix and weld bead to the recited range. In particular, Takahashi does not teach or suggest production of a welded pipe having a hardness difference between the Vicker's hardness HV_w of the weld zone and the Vicker's hardness HV_m of the matrix of 10 to 40 and a ratio $RT (= T_w / T_m)$ between a bead thickness T_w of the weld zone and a thickness T_m of the matrix is 1.05 to 1.3 as defined in the present claims. Therefore, Hiroshi provides no reason for one of ordinary skill in the art to seek the presently claimed steel product or method for its production, the present claim is not obvious over Otsuka, Hiroshi, and Takahashi, alone or in combination. Accordingly, the rejection of claim 5 under 35 U.S.C. §103(a) as unpatentable over Otsuka in view of Hiroshi as applied to claims 2 and 4 above, further in view of Takahashi cannot stand, and should be withdrawn.

In view of the foregoing amendments and remarks, Applicants respectfully submit that the present application is in condition for allowance. Early and favorable action by the Examiner is earnestly solicited. If the Examiner believes that issues may be resolved by a telephone interview, the Examiner is invited to telephone the undersigned at the number below.

Respectfully Submitted,

Date: November 17, 2009

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